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EXAMINER

MONDT, JOHANNES P

ART UNIT	PAPER NUMBER
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3663

DATE MAILED: 03/20/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

10/763,353

Applicant(s)

HOFFMAN ET AL.

Examiner

Johannes P. Mondt

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 05 January 2006.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-43 and 45-49 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-3, 5-18, 20-28, 30-37, 40-43, 45-47 and 49 is/are rejected.
- 7) ☒ Claim(s) 4, 19, 29, 38, 39 and 48 is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|---|---|
| 1) <input type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date <u>3/3/06</u> . | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

Response to Amendment

Amendment filed 1/5/06 forms the basis for this office action. In said Amendment applicant cancelled claim 44, substantially amended claims 11, 12, 14, 23, 36 and 37, and included Remarks in traverse of the rejections in the previous office action. Comments on said Remarks are included below under "Response to Arguments".

Information Disclosure Statement

The examiner has considered items by Haga and Kawasaki, as well as Ohtomo, but is unable to acknowledge the Form PTO-1449 of the Information Disclosure Statement (IDS) filed 3/3/06 for the following reasons:

"The information disclosure statement filed 3/3/06 fails to comply with 37 CFR 1.98(b)(5): Each publication listed in an information disclosure statement must be identified by publisher, author (if any), title, relevant pages of the publication, date, and place of publication. " (37 CFR 1.98(b)(5)).

In particular, "Proceedings of the IEEE" and "Extended abstracts" are not listed with the required details as delineated in the MPEP as shown from the above quote from the MPEP (Appendix R – Patent Rules).

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

1. **Claims 1-2, 7-13, 16, 17, 22-27 and 32-37** are rejected under 35

U.S.C. 102(b) as being anticipated by Cillessen et al (5,744,864) (made of record by Applicant in IDS).

Cillessen et al teach (title, abstract, Figures 2 and 4, cols. 4-10) a semiconductor device (title), comprising: a source electrode and drain electrode (2 and 3 or vice versa: source and drain only non-interchangeable after a purely arbitrary selection of the sign of the voltage difference applied between said source and drain electrode, considering the symmetry of the device; cf. Figures 2 and 4 and abstract), a channel 4 (abstract) coupled to the source and drain electrodes and comprised of a ternary compound containing zinc, tin and oxygen (col. 5, l. 30-50); and a gate electrode 5 (abstract) configured to permit application of an electric field to the channel (that is the very purpose of any gate electrode in the semiconductor device art).

On claim 2: at least a portion of the channel is formed from a zinc-tin oxide compound (col. 5, l. 41), while inherently any zinc-tin oxide compound obtained by forming a compound from ZnO and SnO₂ only has the stoichiometry Zn_xSn_yO_z with positive non-zero values.

On claims 7-10 and 35: one or more (in fact all) of the source, drain and gate electrodes is fabricated so as to be at least partially transparent (see abstract).

On claims 8-9 and 33-34: the channel further includes, based on the presence of the claimed ZnSnO₃ compound, phase-segregated ZnO and SnO₂ by virtue of the finite dissociation constant of ZnSnO₃.

On claims 11 and 36: the further limitation of claims 11 fail to further limitation the semiconductor device as elected, but instead merely further limits the method of making of said semiconductor device. The newly added limitation "adapted to be" (deposited does not in any way change the failure to delineate any structural distinction over and above the limitations of claim 1 on which claim 11 depends because said newly added limitation only states a state not further limited than only by a method of making.

On claims 12 and 37: the source and drain electrodes, *casu quo*, first and second electrodes are formed from indium-tin-oxide (see col. 2, l. 31-41 in conjunction with col. 5, l. 51-60) and are physically separate from one another (Figures 2 and 4), which also is inherent in source and drain electrodes in a functional semiconductor device with channel between source and drain electrode as otherwise said channel could not function because of short-circuiting. The limitation on patterning also included in these claims fails to limit the invention of the semiconductor device *casu quo* thin film transistor but instead only limits their method of making.

On claim 13: the gate electrode is physically separated from the channel by a dielectric material 6 (abstract).

On claims 16-17: Cillessen et al teach (title, abstract, Figures 2 and 4, and cols. 4-10) a three-port semiconductor device comprising: a source electrode (2 or 3), a drain electrode (3 or 2) (see abstract), a gate electrode 5 (abstract), and means for providing a channel 4 (abstract) disposed between the source electrode and the drain electrode configured to permit movement of electric charges there through between the source and the drain electrode, the means for providing a channel formed at least in part from a

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ternary compound containing zinc, tin and oxygen (col. 5, l. 30-50), said means including a zinc-tin oxide compound (loc.cit.), while inherently any zinc-tin oxide compound obtained by forming a compound from ZnO and SnO₂ only has the stoichiometry Zn_xSn_yO_z with positive non-zero values (claim 17).

On claims 22 and 32: one or more (in fact all) of the source, drain and gate electrodes is fabricated so as to be at least partially transparent (see abstract).

On claim 23: the source and drain electrodes are formed of indium-tin-oxide (see col. 2, l. 31-41 in conjunction with col. 5, l. 51-60) and are physically separate from one another (Figures 2 and 4), which also is inherent in source and drain electrodes in a functioning semiconductor device with channel between source and drain electrode as otherwise said channel could not function because of short-circuiting. The further limitation on patterning fails to limit the semiconductor device but instead only limits its method of making.

On claim 24: the semiconductor device further comprises means 6 (see abstract) for providing a dielectric disposed between and physically separating the gate electrode 5 (abstract) from the means 4 (abstract) for providing a channel.

On claim 25: Cillesen et al teach (cols. 4-10, Figures 2 and 4, title and abstract) a thin film transistor (col. 1, l. 5-18: the device of JP 60-198861 is a thin film transistor), comprising: a gate electrode 5 (abstract); a channel layer 4 (abstract) formed from a zinc-tin oxide material (col. 5, l. 30-50); a dielectric material 6 (abstract) disposed between and separating the gate electrode and the channel layer (Figures 2 and 4); and first and second electrodes 2 and 3 (abstract) spaced from each other and disposed

adjacent the channel layer on a side of the channel opposite the dielectric material (Figures 2 and 4) such that the channel layer is disposed between and electrically separates the first and second electrodes (Figures 2 and 4). N.B.: the latter limitation also is merely a defining property of the thin film transistor.

On claim 26: the thin film transistor is by definition of a thin film transistor configured to the limitation of this claim, because a thin film transistor is a field effect transistor.

On claim 27: at least a portion of the channel is formed from a zinc-tin oxide compound (col. 5, l. 41), while inherently any zinc-tin oxide compound obtained by forming a compound from ZnO and SnO₂ only has the stoichiometry Zn_xSn_yO_z with positive non-zero values.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

2. Claims 3, 5, 6, 18, 20, 21, 28, 30 and 31 are rejected under 35 U.S.C.

103(a) as being unpatentable over Cillessen et al (5,744,864) in view of Minami et al (Japanese Journal of Applied Physics, Vol. 23, pp. L 1693-1696 (1994), made of record by Applicant by IDS).

As detailed above, Cillessen et al anticipate claim 2. Cillessen et al do not necessarily teach the further limitation defined by claims 3, 5, 6 or 18. However, it would

have been obvious to include said further limitations in view of Minami et al, who teach high (electrical) conductivity for a particular amorphous (see page L1694, first column, first paragraph; claims 6, 21 and 31) zinc-tin oxide compound, namely: ZnSnO_3 (see abstract) (claims 3, 18 and 28). Because electrical conductivity and mobility are proportional they also report high mobility. Applicant is reminded that mere selection of known materials generally understood to be suitable to make a device, the selection of the particular material being on the basis of suitability for the intended use, would be entirely obvious. In re Leshin 125 USPQ 416.

With regard to claims 5, 20 and 30: it is noted that for $j = \frac{1}{2}$ the compound $(\text{ZnO})_j(\text{SnO}_2)_{1-j}$ is identical to ZnSnO_3 , only the relative amounts, i.e., the ratios, being physical.

3. **Claims 40-43, 45 and 46** are rejected under 35 U.S.C. 103(a) as being unpatentable over Cillessen et al (5,744,864) in view of Ando et al (6,184,946 B1).

As detailed above, Cillessen et al teach a three-port semiconductor device (Figures 2 and 4, cols. 4-10, title and abstract), where the semiconductor device 1 includes a zinc-tin oxide channel layer 4 configured to permit charge transport between a source electrode (2 or 3) and a drain electrode (3 or 2) of the semiconductor device based upon a gate voltage applied to the gate electrode 5 of the semiconductor device., with reference to the abstract and Figures 2 and 4 for numerals. Cillessen et al do not necessarily teach the claimed method of controlling an active matrix display comprising said three-port semiconductor device and also comprising selectively controlling

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activation and deactivation of a pixel of the active matrix display by selectively controlling the gate voltage; however, such is an obvious application of said three-port device, because said three-port device is a thin film transistor (col. 1 and particularly the reference to Japanese document 60-198861, which discloses a thin film transistor) in view of Ando et al, who teach the application of thin film transistors (TFTs) (col. 4, l. 3-25), in particular as switching elements (abstract) used for switching in a method for controlling an active matrix display (title, abstract), wherein the TFT selectively controls activation and deactivation of a pixel of the active matrix display by selectively controlling the gate voltage (cols. 1-col. 2, l. 5: that is how thin film transistor function).

Motivation to include the teaching by Ando et al in the invention by Cillessen et al derives from the obvious advantage of applying a transparent and high mobility TFT such as taught by Cillessen et al to said active matrix display because little light is lost by absorption by the thin film transistor while the device speed is still high. With regard to claim 43, the limitations delineated above are all met because TFT 18 is a switching thin film transistor of the enhancement mode type (normally OFF) (see col. 2, l. 7-13 and abstract), which means that a positive gate voltage creates a conductive channel (see, for instance, Wolf, ISBN: 0-961672-5-3; page 136-137). The further limitations of claims 41-42 are also met because the pixel electrode is connected to the drain electrode. With regard to claim 45 its limitations are automatically met given the above discussion because said active matrix display in the combined invention by Cillessen et al and Ando et al comprises a plurality of display elements configured to operate collectively to display images (see "Background Art" in Ando et al), where each of the

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display elements (as elements of a matrix) includes a semiconductor device (TFT) to control light emitted by the display element, the semiconductor device including: a source electrode, a drain electrode (2 and 3, resp. in Cillessen et al) a channel 4 coupled to the source electrode and drain electrode and comprised of a ternary compound containing zinc, tin and oxygen (col. 5, l. 30-50 in Cillessen et al); and a gate electrode 5 configured to permit application of an electric field to the channel.

On claim 46: at least a portion of the channel is formed from a zinc-tin oxide compound (col. 5, l. 41), while inherently any zinc-tin oxide compound obtained by forming a compound from ZnO and SnO₂ only has the stoichiometry Zn_xSn_yO_z with positive non-zero values.

4. **Claims 47 and 49** are rejected under 35 U.S.C. 103(a) as being unpatentable over Cillessen et al and Ando et al as applied to claim 46 above, and further in view of Minami et al (Japanese Journal of Applied Physics, Vol. 23, pp. L 1693-1696 (1994), made of record by Applicant by IDS).

As detailed above claim 46 is unpatentable over Cillessen et al in view of Ando et al.

Neither Cillessen et al nor Ando et al necessarily teach the further limitation as defined by claims 47 and 49. However, it would have been obvious to include said further limitations in view of Minami et al, who teach high (electrical) conductivity especially for the zinc-tin oxide compound ZnSnO₃ (see abstract). Because electrical conductivity and mobility are proportional they also automatically report high mobility. Applicant is reminded that mere selection of known materials generally understood to be suitable to

make a device, the selection of the particular material being on the basis of suitability for the intended use, would be entirely obvious. In re Leshin 125 USPQ 416.

With regard to claim 49: it is noted that for $j = \frac{1}{2}$ the compound $(\text{ZnO})_j(\text{SnO}_2)_{1-j}$ is identical to ZnSnO_3 , only the relative amounts, i.e., the ratios, being physical.

Allowable Subject Matter

5. ***Claims 4, 14-15, 19, 29, 38-39 and 48*** are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

The following is a statement of reasons for the indication of allowable subject matter:

With regard to claims 4, 19, 29 and 48, the zinc-tin compound Zn_2SnO_4 has not been found within the strict context of prior art defined by the underlying independent claims. Its manufacture is known (Minami et al as cited), but the incorporation into a TFT channel has not been found nor would it have been obvious to do so because of its considerably lower electric conductivity (see Minami et al, page L1693). Also noted is the study by Young et al as made of record in the IDS; however, only future directions of research to improve the relatively low electrical conductivity and mobility of Zn_2SnO_4 are indicated. No other prior art has been found.

With regard to claims 14-15, 38 and 39, the particular material embodiment defined by these claims has not been found in, -or found to be obvious over, the prior

art within the strict context of the thin film transistor as defined by either claim 13 or claim 25.

Response to Arguments

Applicant's arguments filed 1/5/06 have been fully considered but they are not persuasive.

Applicant alleges Cillessen et al do not anticipate a channel comprising a ternary compound containing zinc, tin, and oxygen (page 13 of Remarks). However, as witnessed by the cited portion, Cillessen et al teach, inter alia, ZnO, SnO₂, and compounds formed from these oxides. See in particular col. 5, l. 40-42. Therefore, Cillessen et al clearly anticipate a compound from ZnO and SnO₂. But a compound formed from ZnO and SnO₂ is inherently a ternary compound containing zinc, tin and oxygen. Therefore, this allegation is not true. That a number of different embodiments are simultaneously taught is true but does not detract from the clear anticipation: only a few basic ingredients are taught in the cited reference, with specific inclusion of compounds formed therefrom.

Furthermore, applicant's further traverse based on teaching away is moot in light of the aforementioned anticipation. Nor is there any evidence that Cillessen et al teach away from the invention by doping: high mobility does not mean that it would be counterproductive to further enhance the channel by doping.

With regard to the next point of traverse on "phase segregated ZnO" and "phase segregated SnO₂" in the third paragraph of page 14, as mentioned in the previous office

action, in the presence of any ternary compound and a finite temperature the constituent compounds also are comprised in the material by virtue of the finite dissociation constant of the ternary compound into its binary constituents.

That, as alleged by applicant, "Cillessen et al fails to disclose, teach, or suggest a zinc-tin oxide of any stoichiometry" the clear teaching of a compound of zinc, tin and oxygen mentioned overleaf (see again col. 5, l. 40-42) proves otherwise.

With regard to the comments in traverse of the rejections of claims 12, 23 and 37, that Cillessen teach that in one preferred embodiment the connection electrodes, gate and channel region comprise the same basic material" (see Remarks, page 15), while underscoring the similar physical requirements for electrodes and channel region, does not in any way detract from their teaching of an embodiment in which the electrodes are, in accordance with claim 12 "formed from indium-tin-oxide material", as witnessed from their explicit teaching as cited in the previous office action: see in particular col. 5, l. 51-60. All that applicant can convince of through his comments in the final paragraph of page 15 is that one of the preferred embodiments by Cillessen et al differs from the claimed invention. However, a preferred embodiment does not teach away from their other embodiments, and, in fact, Cillessen et al explicitly state that a covalent oxide of indium-tin oxide (ITO) is highly suitable in this regard, and hence the cited embodiment is in its own right a preferred embodiment.

With regard to the traverse of the rejections under 35 USC 103(a) as discussed on pages 16-17 of Remarks, said traverse is based on applicant's allegation that "the application of zinc-tin oxide of the present application is different from the application of

the zinc-stannate films of Minami et al, rendering the combination of Cillessen et al and Minami et al inappropriate". However, this is not even the true issue: the question is whether one of ordinary skills would have considered it obvious to combine the teaching by Minami et al with the invention by Cillessen et al, not with the application. Even *arguendo*, both Cillessen et al and Minami et al are interested in the optimization of the material selection based on mobility (see Cillessen et al, col. 5, l. 30-50, and Minami et al, second paragraph of the Introduction; keeping in mind that mobility proportional to conductivity), while Cillessen et al can only be interpreted as to agree with Minami et al by having similar requirements for channel and electrode materials, as mentioned above.

With regard to the traverse of the use of Ando et al based on band gap as formulated on page 18, the device by Ando et al merely is needed to show that the three-port device has an entirely obvious application in the form of a transistor in a matrix display device. Such application is not rendered less obvious by pointing out that the band gap of the material is different: not in the specific spectrum, but in the obviousness to apply the invention to the field of active matrix displays because of its reduced light loss and high device speed, as delineated in the explanation of motivation in the previous office action.

All remaining arguments on page 19 in traverse appear to fall back to the principle arguments on anticipation. Hence they are also not persuasive for the above reasons.

In light of the above considerations the rejections over the prior art as cited in the previous office action herewith, regrettably, must be made to stand.

Conclusion

Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire **THREE MONTHS** from the mailing date of this action. In the event a first reply is filed within **TWO MONTHS** of the mailing date of this final action and the advisory action is not mailed until after the end of the **THREE-MONTH** shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than **SIX MONTHS** from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Johannes P. Mondt whose telephone number is 571-272-1919. The examiner can normally be reached on 8:00 - 18:00.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Jack W. Keith can be reached on 571-272-6878. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

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Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

JPM
March 14, 2006


JACK KEITH
SUPERVISORY PATENT EXAMINER